CLAIMS

We claim:

1. A spray cooling system comprising:

a cooling surface with a hotspot zone producing a high heat flux;

a sprayer in a spaced apart relationship to said hotspot zone and capable of transforming a supply of liquid coolant into a continuous pattern of droplets that impinge and create a thin coolant film generally within said hotspot zone; and

wherein said thin coolant film cools said hotspot zone primarily through evaporation.

2. The spray cooling system of claim 1, wherein said high heat flux is greater than 300 watts per square centimeter.

3. The spray cooling system of claim 1, wherein said hotspot zone includes an array of etched microchannels.

4. The spray cooling system of claim 1, further including a vapor management protrusion surrounding said sprayer.

5. The spray cooling system of claim 1, wherein said sprayer is an atomizer.

6. The spray cooling system of claim 1, wherein said sprayer is at a non-perpendicular angle to said cooling surface.

7. The spray cooling system of claim 1, wherein the mass flow rate of said impinging droplets is greater than the mass flow rate in which said thin coolant film is evaporated.

8. A spray cooling system comprising:

a cooling surface with a hotspot zone producing a high heat flux;

a sprayer in a spaced apart relationship to said hotspot zone and capable of transforming a supply of liquid coolant into a continuous pattern of droplets that impinge and create a thin coolant film within said hotspot zone;

wherein said thin coolant film cools said hotspot zone primarily through evaporation; and

wherein non-evaporated amounts of said thin coolant film dispensed within said hotspot zone creates a thicker coolant film over the remaining areas of said cooling surface.

9. The spray cooling system of claim 8, further comprising at least one secondary orifice for adding said coolant to said thick coolant film.

10. The spray cooling system of claim 9, wherein said secondary orifice is a incremental drop ejector.

11. The spray cooling system of claim 8, further comprising a vapor management protrusion surrounding said sprayer.

12. The spray cooling system of claim 8, wherein at least a portion of said cooling surface includes a plurality of microchannels.

13. The spray cooling system of claim 8, wherein said sprayer is at a non-perpendicular angle with said component.

14. The spray cooling system of claim 8, wherein said sprayer is an atomizer.

15. A spray cooling system comprising:

an electronic component with a cooling surface having a hotspot zone producing a high heat flux;

a sprayer in a spaced apart relationship to said hotspot zone and capable of transforming a supply of liquid coolant into a continuous pattern of droplets that impinge and create a thin coolant film within said high hotspot zone;

wherein said thin coolant film cools said hotspot zone primarily through evaporation; and

wherein non-evaporated amounts of said thin coolant film dispensed within said hotspot zone creates a thicker coolant film over the remaining areas of said cooling surface.

16. The spray cooling system of claim 15, further comprising at least one secondary orifice for adding said liquid coolant to said thick coolant film.

17. The spray cooling system of claim 16, wherein said secondary orifice is an incremental drop ejector.

19. The spray cooling system of claim 15, further comprising a vapor management protrusion surrounding said sprayer.

20. The spray cooling system of claim 15, wherein at least a portion of said cooling surface includes a plurality of microchannels.

21. The spray cooling system of claim 15, wherein said sprayer is at a non-perpendicular angle with said component.

22. The spray cooling system of claim 15, wherein said sprayer is an atomizer.

23. A thermal management system comprising:

a cooling surface with a hotspot having a first heat flux;

an at least one sprayer in a spaced apart relationship to said hotspot and capable of transforming a supply of liquid cooling into a continuous pattern of droplets that impinge and create a thin coolant film on said hotspot;

wherein said thin coolant film absorbs said first heat flux;

wherein a radial flow of said thin coolant film creates a thicker coolant film over a second zone of said electronic component, said second zone producing a second heat flux that is less than one-third the magnitude of said first heat flux; and

wherein said thicker coolant film absorbs said second heat flux.

24. The thermal management system of claim 23, further comprising at least one secondary orifice for adding said coolant to said thicker coolant film.

25. The thermal management system of claim 24, wherein said at least one secondary orifice is an incremental drop ejector.

26. The thermal management system of claim 23, further comprising a vapor management protrusion surrounding said at least one sprayer.

27. The thermal management system of claim 24, wherein at least a portion of said cooling surface includes a plurality of etched microchannels.

28. The thermal management system of claim 24, wherein said sprayer is at a substantial angle with said component.

29. The thermal management system of claim 24, wherein said second heat flux is less than 100 watts per square centimeter.

30. The thermal management system of claim 24, wherein said sprayer is an atomizer.

31. The thermal management system of claim 24, wherein a hydraulic jump exists between said thin coolant film and said thicker coolant film.

32. A method of cooling an electronic component with at least one high heat flux hotspot, said method comprising:

dispensing an at least one stream of liquid droplets with the momentum necessary to result in high heat flux evaporative cooling of said at least one hotspot, said dispensing also resulting in a thick film that cools the non-hotspot areas of said electronic component.

33. The method of claim 32, wherein said at least one stream of liquid droplets are dispensed at a non-perpendicular angle to said hotspot.

34. The method of claim 32, wherein said at least one hotspot includes an array of etched microchannels.

35. A liquid cooling system comprising:

an electronic component to be cooled having a cooling surface with a hotspot producing a first heat flux, wherein the non-hotspot portion of said cooing surface produces a second heat flux;

wherein said first heat flux is at least three times greater in magnitude than said second heat flux; and

an at least one sprayer in a spaced apart relationship and at a non-perpendicular angle to said hotspot, wherein said at least one sprayer dispenses

droplets onto said hotspot in a fashion that creates a thin coolant film on said hotspot and a thick film on said non-hotspot portion of said cooling surface, said thin coolant film capable of cooling said hotspot and said thick film capable of cooling said non-hotspot portion of said cooling surface.

36. The liquid cooling system of claim 35, wherein said hotspot includes an array of etched microchannels.

37. The liquid cooling system of claim 35, wherein said first heat flux is at least three times greater in magnitude than said second heat flux.

38. The liquid cooling system of claim 35, further including at least one secondary nozzle for adding a supply of liquid coolant to said thick film.

39. The liquid cooling system of claim 38, wherein said at least one secondary nozzle is an incremental drop ejector.

40. A continuously replenished evaporative cooling film created upon a surface to be cooled, said cooling film comprising:

a thin-film zone generally located over and capable of cooling a high heat flux portion of said cooling surface; and

said thin-film zone flowing radially into a thicker-film zone located over and capable of cooling a low heat flux portion of said cooling surface.

41. The continuously replenished evaporative cooling film of claim 40, wherein said thicker-film zone is separated from said thin-film zone by a hydraulic jump.

42. A cooling film for continuously absorbing heat from a surface to be cooled, said surface having a first zone with a first heat flux and second zone having a second heat flux, said cooling film comprising:

means for said cooling film to absorb heat from said first zone at a greater rate than said second zone.

43. A cooling film for continuously cooing a surface of an electronic component:

said electronic component having a first component zone generating a first heat flux and a second component zone generating a second heat flux;

said cooling film having a thin-film evaporative zone located over said first component zone and having a thickness capable of absorbing said first heat flux in the general proximity of said first component zone; and

said cooling film having a thick-film cooling zone located over said second component zone and having a thickness capable of absorbing said second heat flux.

44. The cooling film of claim 43, wherein said first heat flux is at least three times greater than said second heat flux.